CARBON OFFSETS IN AVIATION

The effectiveness of carbon offsets in increasing the environmental image of airlines

Touko Topias Heikkinen

International Business
Bachelor's Thesis
Supervisor: Russell Warhurst
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ABSTRACT OF
BACHELOR'S THESIS

Author: Touko Heikkinen

Title of thesis: Carbon offsets in aviation: The effectiveness of carbon offsets in increasing the environmental image of airlines

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Objectives

The main objectives of this study were to analyze the effects of climate change on airlines and study the effectiveness of carbon offsets as a tool to increase environmental trust in airlines, which would help airlines in retaining environmentally conscious consumers. The thesis tries to study options to make airlines environmentally and economically sustainable.

Summary

Airlines are an important part of the current economic system, but the airline industry contributes around 3% of all global greenhouse gas emissions. Carbon offsets, a practice where a company pays for a carbon-reducing project, offsetting own emissions, was analysed as a potential tool to make airlines more sustainable environmentally and economically. Using a survey, peoples' attitudes on sustainability, airlines and carbon offsets were measured.

Conclusions

Amongst respondents, sceptical attitude towards carbon offsets was present, but the respondents seemed to hedge a lot in their answers relating to offsets. They were also ready to pay for carbon offsets, even though they might have been uncertain about the effectiveness. The surveyed people were not as knowledgeable on offsets as on environmental issues in general, which is in line with earlier similar studies. Using biofuels and fuel-efficient aircraft were perceived as the most effective tools by the respondents. Under normal prices, most people seem to be willing to offset at least a signification portion of the emissions of their flight.

Key words: *sustainability, airlines, carbon offsets, environment*

Language: English

Grade:

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1. INTRODUCTION

1.1 Background

One of the main developments in the 21st century is the increased awareness of climate change and its possible destructive effects on many current industries and economies. Whilst humanity is increasing the amount of carbon dioxide and other greenhouse gases, globalisation is generating extraordinary development for human lives. One of the main motors for globalisation is aviation. As people have access to a transportation method, which can transport masses rapidly from cities around the world to each other, the world has become smaller.

As climate change is becoming one of the biggest crises and flying creates carbon emissions, a dilemma is born, where the reduction of aviation would reduce the effect of climate change, but improving the environmental sustainability of the economies would at the same time likely affect economic growth negatively by removing widely used infrastructure. If the aviation industry does not change, it accelerates climate change creating a lot of damage that will contribute to large problems, which will very likely damage economies in many more ways. Neither option seems preferable, but evolving the airline industry can be the only sustainable option.

1.2. Research Problem

The thesis is researching a problem, how airlines can become environmentally and economically sustainable. The thesis focuses on environmental sustainability but takes economic sustainability into account as the necessity for a company to operate. The thesis does not consider social sustainability.

As the public perception of climate change increases, flying is often seen as an environmentally damaging act. If this leads to people reducing flying due to their environmental concerns, airlines' revenues are under threat. As such, environmental sustainability could be seen in the long-term as a wise move also related to economic sustainability.

The thesis is written at a bachelor's level and cannot go to depths on a wide scale so the topic is focused on the use of offsets by airlines. In the "Conclusions" part of the thesis, the relevance of the thesis to other industries is also considered.

1.3. Research questions

- RQ1: Do consumers have trust in the effectiveness of carbon offsets?
- RQ2: Does negative environmental trust in airlines reduce the likelihood of flying?
- RQ3: How willing are consumers to pay more for a flight, which emissions are offset?

Carbon offsets do not have an economic benefit for an airline if the customers do not believe in its effectiveness. If offsets are found to be ineffective by customers, airlines should move to alternatives. In addition, greenwashing allegations and the impact of advertisement are studied relative to the question.

There is only one hypothesis related to the research question one. Otherwise, basic analysis of the data from the survey is used to explain, how the trust in the effectiveness of carbon offsets changes.

- Increased knowledge on offsets increases the perceived effectiveness of offsets.

To confirm that the environmental and economic sustainability of an airline has a link, the research question two is studied. If the customers do not care about the environmental image of an airline, it is easy for an airline to be only economically sustainable and leave environmental problems to others as an example of the tragedy of the commons. There are three hypotheses related to research question two:

- Environmentally conscious people reduce flying due to their environmental concerns
- If people in a person's social circles have reduced flying, the person is likelier to have reduced flying as well.

- Lesser trust in the airline's environmental actions reduces overall attitudes on airlines.

The research on research question 3 goes deeper into the purchasing habits of customers. It is studied, if people are willing to pay more for carbon offset products and how much more. Four different factors affecting the willingness to pay for offsets are introduced: wealth, flight shame, the effectiveness of offsets and environmental consciousness. Four similar hypotheses were made from these:

- People who have flight shame are more likely to buy offsets to alleviate moral discomfort.
- People, who think that carbon offsets are more effective, are more likely to buy carbon offsets
- An environmentally conscious person is more likely to buy offsets if they are wealthier.
- Environmentally conscious people are more likely to purchase offsets

1.4. Research objectives

The research problem is assuming that the consumers would care about the environmental effects of flying in their purchase decisions. As such, if the consumers are likely to reduce flying, if they find it unsustainable, is researched. In addition, the attitudes towards offsetting are studied as it does not work as a solution if consumers find it ineffective or even greenwashing.

The study focuses on the relevance of offsetting for airlines making important to find out if carbon offsetting schemes provide significant brand or marketing value for companies. If carbon offsetting has good PR benefits for airlines, the costs could be offset by increasing revenues.

Economic sustainability is important for businesses to keep them afloat. The cost structure of carbon offsetting is going to be studied with some research into the main alternatives as a comparison.

Airlines, like all companies, are subject to regulation. As a minor research objective, in the literature review, the future of environmental regulation in aviation is researched, as it can have a major effect on the airlines' possible or required carbon footprint reduction tools.

1.5. Definitions

Carbon offsetting is the practice of paying for environmentally friendly projects, which reduce emissions to offset the negative environmental costs in company's own operations, basically "outsourcing" the environmental actions. Some carbon offsetting by airlines is mandated by regulatory bodies and some are offered voluntarily by the airlines. This thesis focuses on the non-mandatory offsets as airlines have more choice in implementing them.

The non-mandatory offsets can be divided into two categories: additional services and integrated offsets. Depending on airlines, some offsets are offered as additional services, where the consumers decide if their travel's emissions are offset. Some of the offsets are, on the other hand, are already integrated into the price of a standard ticket. Some airlines also provide a middle-ground by, for example, including offsets in business, first-class or youth flights, whilst excluding them from economy flights.

The main regulatory bodies affecting the mandatory use of offsets amongst airlines are currently the International Civil Aviation Organization (ICAO) and European Union (EU). ICAO, which is the United Nations (UN) body responsible for principles in aviation is on their way introducing Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). EU has created EU Emission Trading Scheme (EU ETS) to limit emissions and airlines are part of it, whilst CORSIA is in development. Airlines can use carbon offsets, amongst other tools, to fulfil environmental regulation in EU ETS.

As explored in the literature review, many earlier studies on the topic have researched the consumer's willingness to pay for voluntary offsets offered by airlines. To conserve space and consolidate alternative words for the same description, the thesis uses

willingness to pay (WTP) as a word to describe the consumer's willingness to purchase and use carbon offsets to offset their personal flights.

To make the thesis more readable and usable in the business world, many environmental science terms are simplified. In the thesis, simplified terms like carbon footprint, environmental friendliness and effect on climate are used instead of radiative forcing to describe the humans' effect on global warming.

As one of the main alternatives to carbon offsetting, biofuels are explored in the thesis. There are many types of biofuels, which are often in this thesis merged into the umbrella term of biofuels. Biofuels, in this thesis, mean fuels, which are sourced from renewable sources, unlike fossil fuels. Biofuels can be divided into fuels made from waste or from prime materials, which are materials made just for the purpose of biofuels. The line between prime materials and waste is not a clear one and some biofuels could be considered both. In addition, using fuel mixtures with both biofuels and fossil fuels in the mix is also considered in the thesis as an action of using biofuels.

The survey included questions about flight shame and greenwashing as they can have a major effect on the perceived effectiveness and use of different emission-reducing tools. Greenwashing is defined, amongst other definitions, as "the act of misleading customers and potential customers into believing that a product or service is environmentally friendly". If offsetting is found to be perceived as greenwashing, it could even have a negative effect on the environmental trust of an airline. Flight shame is defined, amongst other definitions, as "the feeling of climate guilt associated with airline travel". If people have flight shame, it is expected that they are more likely to reduce flying posing a danger to airlines.

2. LITERATURE REVIEW

2.1. Introduction

The purpose of the thesis is to evaluate the use of carbon offsets in the airline industry and the viability of it as one sustainability measure. Therefore, the purpose of this

literature review is to critically analyse earlier literature and research in carbon offsetting and corporate responsibility in the airline industry. Researching the literature should provide insight into the current use of carbon offsets. As the thesis' focus is on business and not climate science. the climate science side of the literature is more of introduced as the basis for business actions and as such, not so deeply criticized. The main source of the underlying climate science in this literature review is the Intergovernmental Panel on Climate Change, abbreviated as IPCC. Only a small part of their reports are cited on the literature review and as such are included in the references, even though many other reports were a part of the literature of which the thesis is based on.

2.2. Carbon Offsets and their effectiveness

As it can be very hard to lower greenhouse gas emissions of business to a minimum, an idea of compensating the emissions by extracting emissions from the atmosphere has been an ongoing idea in mitigating climate change. Carbon offsets reached public consciousness after the Kyoto Protocol in 1997. In the Kyoto Protocol's Article 6, carbon market mechanisms including carbon offsets were introduced (UNFCCC, 1997).

Carbon offsets can be easily explained by thinking it as a way to "outsource" climate efforts. As the effects of greenhouse gases are global, reducing them from another place does the same for the atmosphere. As calculated by the International Civil Aviation Organization, ICAO, a round trip in Economy class from London to Los Angeles has a carbon footprint of almost a tonne of CO2. By paying for a project, which would reduce emissions by a tonne.

As a comparison, a hectare of restored peatland keeps 2.778 tonnes of CO2 from being released into the atmosphere every year (Luonnonvarakeskus, 2018), which accounts for 3 roundtrips between Los Angeles and London every year. By funding projects, like restoring peatland, which would not otherwise be done, climate efforts can be "outsourced".

Carbon offsets are often seen as a temporary solution. As there is currently no valid alternative for a combustion jet engine for long-haul flights and all fuels used by jet engines produce emissions. Biofuels are counted as almost carbon neutral if they are made from waste, but there is currently not enough biofuel for the whole industry (Bailis, Broekhoff & Lee, 2016). Other carbon-neutral energy sources are developed, like hydrogen and electricity, but these fuels are though currently not ready for commercial implementation. Airlines could find emission reductions from other operational activities than flight, but for the flight, the largest source of emissions for airlines, there is currently a limited supply of solutions, including, carbon offsets.

There are two major types of carbon offsets, compliance (CDM) market established by the Kyoto Protocol, which will be revamped in 2020 as decided by the Paris Agreement and voluntary market, which the researches describe as “an informal or ‘parallel’ market currently governed by a mix of non-governmental and private-sector organizations”. This thesis focuses on the voluntary market, as airlines do not have a say in the participation to CDM, but they still could find opportunities in the CDM market or its successor.

Still, some air travel fits under the CDM market. The internal flights in the EU fit under the EU emissions trading system (EU ETS). The EU ETS works so that there is a limited number of emission allowances for companies. If a company would go over the allowance limit, they would have to buy allowances from other companies, who have spare allowances to sell or would have to participate in carbon offsetting through CDM. After 2020, the CDM credits won’t be allowed, but a similar scheme is likely to emerge. As such, it is important for companies to research if they could make internal efforts, which would be cheaper than buying allowances from other companies or offsetting credits.

Currently, the scope only extends to internal flights, but the International Civil Aviation Organisation, an agency of UN responsible for principles in aviation, is exploring the inclusion of air travel globally into a carbon trading market. If these efforts would fail, in 2024, all flights to or from Europe would be considered in the EU ETS.

The plan by ICAO, CORSIA is almost ready to launch, if the participants will agree on the details, which would during the 2020s mandate airlines in many countries to use offsetting or some other tools to keep their emission levels in the 2019-2020 state. CORSIA is currently supposed to implemented in 2021 in 82 countries, with an estimated over 75% of aviation activity included in CORSIA after 2021 and over 90% after 2027. This could have a major increase in demand for offsets increasing their price.

The ongoing COVID-19 coronavirus pandemic could have a significant impact on CORSIA, as the emission levels are supposed to be kept on the 2019-2020 levels. If planes are grounded for long times due to COVID-19, the baseline for the emissions is going to reduce. Airlines would then have to reduce emissions to a lower level than originally expected.

As the thesis is exploring the use of offsets as sustainability practises, it is important to know about the effectiveness and efficiency of offsets. The efficiency is important as companies do not want to spend unnecessary resources on offsetting. Effectiveness is important as it is a benefit to the company if their actions result in desired outcomes. It is also important to distinguish the perceived effectiveness and efficiency by consumers with the effectiveness and efficiency estimated by research. The perceived values are at least on short-term most important to companies, as it influences the consumers' purchasing decisions, but long-term the efforts should be validated by research.

A highly cited publication comparing different emission standards was done by Kollmuss, Zink and Polykarp (2008). The publication did though have a conflict of interest as it was commissioned by WWF Germany and WWF is a founder of Gold Standard, the second largest offsetting standard. The study was conducted by the Stockholm Environment Institute, a reputable, independent NGO and seemed to have rigorous research in it. It identified that the offsetting standards have much variance creating a market, where the offsetting can mean very different projects of effect.

The efficiency of offsetting is theoretically high as the emission mitigation is done, where it is the cheapest. but some obstacles still apply. Cacho, Lipper and Moss (2012) discovered that there are major transaction costs in carbon offsetting projects increasing their costs for airlines. A decrease of transaction costs could be found from "additional growth of institutional and technical infrastructure…to allow smallholders in developing countries to participate in carbon markets…further growth into regulated markets requires the presence of aggregators who are willing to invest and undertake contracts". These actions would be out of reach for most airlines and expensive to do alone. Airline alliances and governments have as such the biggest chance in decreasing transaction costs. The study, at large, does not have a that significant effect as even with the transaction costs, the emission mitigation projects seemed to be efficient.

The larger question lies on the effectiveness. Many offsetting projects airlines use have been found to have lax requirements contravening with the airlines' marketing of carbon-neutral flights (Gössling et al., 2007). There though seems to be enough carbon offsets with medium-to-high greenhouse emission reductions (Bailis, Broekhoff & Lee, 2016). The airlines have to make a decision between more expensive, but less controversial offset projects and the cheaper offsets currently still in use. They could also explore a possibility of offsetting their emission multiple times or buying a combination of projects of varying rigidity creating a portfolio of projects that on average could be thought as valid.

In addition to scholarly articles, non-scholarly, reputable literature on the subject has been made. In a Nature column, Anderson (2012) pointed out many negative side effects of carbon offsets, which can increase emissions and even claims that "offsetting is worse than nothing" (p.7). For example, he discusses the difficulty of estimating an offset project's effect, which makes carbon reduction claims impossible to assure. In addition, carbon offsets will likely increase economic growth, which creates more emissions. The column seems to take a pretty pessimistic approach to the subject, but brings up many good points that should be considered.

2.3. Environmental effects of aviation

Recently, it was estimated that aviation accounts for over 2% of the CO2 emissions by the International Council on Clean Transportation (Graver, Rutherford & Zhang, 2019). More worryingly, it was estimated in the report that the annual compound growth rate of emissions is 5.7%, meaning that the climate impact of aviation is growing rapidly.

The 2% can be seen as misleading as already before the change of the millennium, the IPCC estimated (Dokken et.al, 1999) that 3.5% of radiative forcing of greenhouse gases was accounted by (subsonic) aircraft. Radiative forcing means the warming effect of gases in the atmosphere by human activities. The difference was caused by all the other greenhouse gases aviation produces and high altitude, where the emissions are released in the atmosphere.

In a Nature Climate Change article, the radiative forcing of aircraft-induced clouds (AIC), often called contrails, was also expanded on (Burkhardt & Kärcher, 2011). The effect of contrails was found to be still highly uncertain as large scale climate models do not, as of yet, work with estimating AIC effects with possible effects ranging from a negligent part of aeroplane emissions to being the most radiative force produced by aeroplanes (Burkhardt & Kärcher, 2011). The IPCC report from 1999 already acknowledged this as a risk with high effect, but also high uncertainty (Dokken et.al., 1999).

As research on AIC becomes more certain, there is a possibility for major changes in the measured impact of aviation, resulting in a higher need in climate sustainability efforts by airlines. Currently, the International Civil Aviation Organisation, an agency of UN responsible for principles in aviation has not yet included AIC in their efforts on sustainability with their main focus on CO2 (ICAO, 2016).

Summing up, CO2 emissions are not the only source of emissions for flights but are the most important. The current focus on CO2 by companies can be seen as rational, as the research is on it is of the highest certainty (IPCC, 2014). Companies have to though still be ready for major actions if flying will be found more polluting than expected.

2.4. Consumer willingness to pay for offsets

Many surveys in the topic have studied the consumers' willingness to pay for voluntary carbon offsets. Many of these studies have focused on air travel and these surveys have proven to be a reliable source of literature on the topic, increasing its role on the thesis.

Many studies on the topic so far have focused on voluntary carbon offsets. Voluntary carbon offsets are a safer practise for airlines as most of the costs are covered by passengers, who pay for the offsets. Various studies have shown varying levels of consumer willingness to buy offsets. In a study conducted at a Taiwanese airport, around 30% of respondents were willing to pay the current market price for a full offset of their emissions for the flight, whilst almost 50% were willing to compensate for at least 50% of their emissions.

The highest WTP was recorded with people flying to and from Europe supporting the assumption that Europeans are more active in environmental sustainability. These flights though had the highest emissions being of the longest distance creating a significant rift between actions and values.

A study in Australia and New Zealand researched tourists' and tourism experts' willingness to plant a tree to offset their emissions (Becken, 2004). About half of the respondents were ready to plant a tree as compensation. The study used a convenience sample with nationality quotas, which means that the results might not be that valid. In the study, offsetting was restricted to planting trees only instead of paying for varied offsetting projects in the voluntary market. The study divided respondents into five groups, which were found to be later useful in the creation of a conceptual framework.

Schwirplies and Ziegler (2015) researched more broadly the motives for climate protection activities. Their research has a correlation with the narrower studies explained above explaining the reasons people are voluntarily paying for offsets. The paper mostly used earlier literature as theory behind motives, but it was backed up by a large survey in both USA and Germany.

One of the most important findings in the study was the large differences between American and German answers in the survey. This could explain the differences found in Taiwan between flights to Europe and Asia as well as with the study conducted in New Zealand.

Choi, Gössling and Ritchie (2018) did another survey in Australia. The study found that consumers are much more willing to pay offsets for domestic flights than international flights, which contradicts the Taiwanese survey, where long-distance flights to Europe had the highest WTP, which though can be contradicted by the different cultural composition of people on flights to Europe.

Sweden is often regarded as a highly liberal and environmentally friendly country, which has even introduced an air travel tax (Skatteverket). The tax could have an adverse effect, where the tax could be substituting the use of offsets. In a 2009 study, most people were willing to pay for offsets, but only 6% had actually paid for offsets out of participants knowledgeable of offsets. Around 25% of respondents were willing to fly less, a worrying figure for airlines. Airlines could try to retain some of these customers by providing them the chance to offset their flights. (Gössling et al., 2009)

The results from Sweden can be seen as a precursor for flygskam. The “flight shame” movement, which has emerged from Sweden recently, advocates for stopping flying for good due to climate concerns and has caused major negative growth in especially domestic air travel in Sweden. The “flight shame” movement is a risk for the revenues of airlines with negative growth already seen after a long positive growth period. Most of the decrease is explained by a significant drop in domestic travel by air, which could be explained by the occurrence of more relevant substitutes. A similar effect has been seen in other European countries, like France and Germany, where high-speed rail travel has reduced domestic and short-haul flying.

If “flight shame” starts to spread more, the airlines have to provide believable efforts to retain customers or focus on markets with few substitutes, for example, long-haul flights. The flag carrier in Sweden, SAS, already offers offsets, but it hasn’t stopped the movement. The concept of “greenwashing”, where climate efforts by companies are marketed as significantly better than reality, could be one major reason for the

inability of offsets to retain climate-conscious people. There have been greenwashing allegations in research, which is expanded upon later on.

2.5. The knowledge of offsets amongst consumers

The low understanding of carbon offsets has been supported by research from the same group of researchers (Polonsky, Grau & Garma, 2014). Their study had a good sample size but didn't specify their survey questions, which leaves opportunities for skewing the results. The study also had a US-specific sample, so the results might differ globally. The results had already been found to vary between USA and Germany with highly educated people by Schwirplies and Ziegler (2015), who attributed the difference by the "insignificant effects of education on climate change beliefs and concerns in the United States (which is obviously due to the underlying political and ideological orientation (of education))." There were though still a significant group of people in Germany who had little or no knowledge of offsets.

USA though counts for 24% (Graver, Rutherford & Zhang, 2019) of the emissions, so it accounts for a huge portion of the possible market of aviation emission offsetting. The low consumer understanding has been also validated in other countries by other studies, for example, in Taiwan (Lu & Shon, 2012) strongly pointing to a true lack of general understanding of offsets globally. In the USA, additionally, the public has a lot of sceptics on the anthropogenic effects on climate change.

Also, in the Swedish study, where the understanding was also studied, most respondents didn't have a good understanding of offsets. Only 24% of respondents on average had an understanding on offsets. The largest understanding was with the most flying people, who were also the most compensating flyers. (Gössling et al., 2009)
An intriguing scholarly article found "the Al Gore effect", wherein the areas, where the Al Gore's documentary "An Inconvenient Truth" on carbon offsets was shown, people started to at least in short term buy 50% more carbon offsets (Jacobsen, 2010). The result supports the notion that knowledge on offsets could make people more likely to buy offsets and shows also potential for marketing strategies. The study seems to be

done with good integrity, even though the magnitude of the results seemed unexpected in the beginning.

2.6. Company implementation

A study “The New Greenwash? Potential Marketing Problems with Carbon Offsets” discussed many risks of marketing offsets and deemed it to have a high risk of being used as greenwashing (Polonsky et al., 2010). Greenwashing could have been done according to them due to a complex system of different global standards of varying rigidity supported by Kollmuss, Zink and Polykarp (2008) and a low consumer understanding of carbon offsets.

There are not many economic models for greenwashing, but a model by Lyon and Maxwell expects quantifiable damages from greenwashing. (Lyon & Maxwell, 2011) The economic model mostly uses a viewpoint of the activist or auditor, who might accuse companies of greenwashing, but can have implications for companies.

An important viewpoint from the model is that the level of environmental actions might not alleviate greenwash allegations. When an airline would release more details on their actions, there is more information leading to more points of failure. On the other hand, “turtling” and not releasing any information is an easy way to call activists to investigate. An airline has to be careful in the balancing practise between positive marketing and acknowledging the faults in the product. By presenting carbon offsets as a perfect solution can make even more informed consumers turn away.

The researchers pointed out some valid examples of potentially misleading marketing. Companies might get a negative effect from misleading or misunderstood marketing from regulators or public outrage. Important information in the study is that some governmental agencies like US Federal Trade Commission and Australian Consumer and Competition Commission were investigating false advertising under offsetting. Airlines have to be careful to avoid conflict with authorities.

One study suggested that airlines should follow British Airways' initiative and provide carbon offsets in more understandable and simpler packages of rounded-up costs, even if they might not fully reflect the greenhouse emissions produced by the flight (Choi, Gössling, & Ritchie, 2018). Even though they had suggested the solution as a way to balance the price gap of offsetting between international and domestic flights, helping consumers to pay their own amount, the solution was not the focus of the research and has just hypotheses to back it.

2.7. Conceptual framework and conclusions

The airlines have an interest in retaining the current growth of air travelling. If short-haul flights become less and less utilized, airlines have to focus on long-haul flights or divert their operations into less emission-intensive travel options like rail. The environmental concerns on aviation is currently a big concern for growth. A goal for CSR is the sustainable long-term success of operations. Environmental activists are pushing for environmental sustainability, but companies need economic sustainability to keep going. If the share of environmentally conscious consumers would increase, as is expected, airlines have to combine environmental and economic sustainability.

Currently one of the main sustainability efforts of airlines is offsetting emissions. The practice is often efficient but has larger questions on effectiveness. If companies want to retain their customers using offsets, they have to fill some criteria listed in the conceptual framework below. The thesis will study if carbon offsets can fit the criteria for it to be applicable or should airlines focus on other actions.

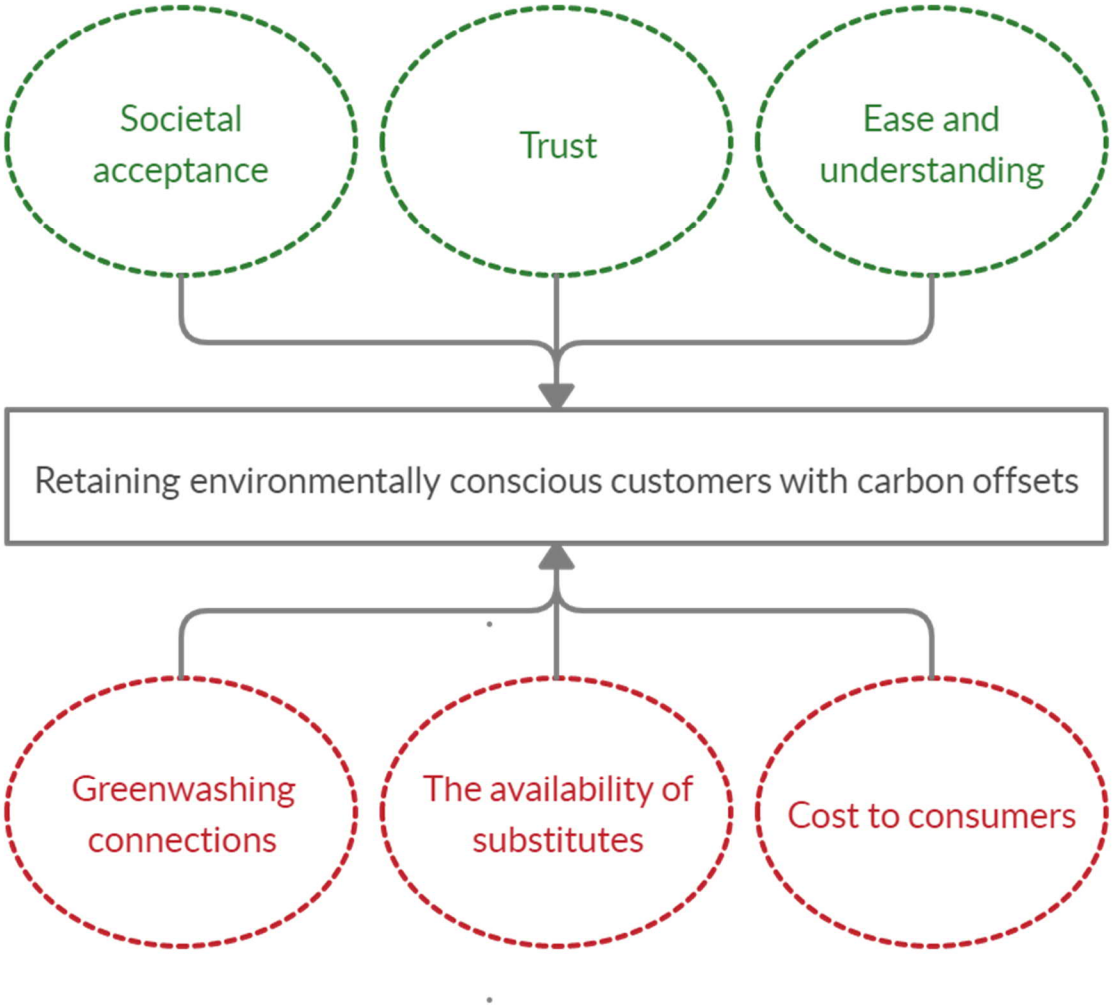

Figure 1: Conceptual framework

3. METHODOLOGY

This thesis used primarily quantitative analysis. Primary data in this thesis was collected using a survey. The sample was a type of convenience sample. The respondents were reached by stopping people online at the campus and sharing it in Facebook, Reddit and the campus' mailing list. Some people were also asked to distribute the survey to their respective networks. The sample is analysed further in the "Sample analysis" section.

The survey was conducted in Webropol 3.0 software and was open for responses for 9 days from 4th March to 13th March 2020. During the time, 90 people finished the

survey and 33 people started responding but did not finish the survey. All questions except for monetary situation and email were mandatory to answer. It was possible to go back and forth in the survey and change answers, but it was not possible to return to the survey after submitting the responses.

The survey was done anonymously, except people had to chance to participate in a raffle by providing their e-mail. The e-mails were not used for the purpose of the thesis and will not be used for demographical analysis.

The survey had some demographical questions to analyze some basic demographics of the respondents. Age, gender, nationality, highest level of education and monetary situation were measured. The thesis included also questions regarding respondents' environmental consciousness and environmental knowledge as these would have been likely intervening variables.

Most questions had possible responses in a Likert-scale, where respondents had to pick between agreeing or disagreeing or from an adjective and its antonym. In most questions, where there were two clear opposites, a scale of 1-6 was used. When respondents were asked their opinion, the left end of the scale (1) meant "totally disagree" and vice-versa, the right end of the scale (6) meant "totally agree". Because respondents picked between "totally agree" and "totally disagree", instead of more hedging options, the responses are likelier to shift to the middle than the ends of the scale.

When respondents were asked to pick between an adjective and an antonym, the 1-6 Likert scale was still used. The adjectives and their antonyms were picked to present the full scale from an adjective to its full antonym with as linear scale as possible. The linearity is likely not as strong as with the totally agree to totally disagree options, but the answers should have interval scale attributes.

In two questions, a 1-4 scale was used instead of the 1-6 Likert scale, where 1 signalled no effect, 2 a minor effect, 3 an effect and 4 a major effect. The options were picked so that there would be as close to a standard interval between the answers. The 1-4

scale was used instead of a 1-6 scale, as the scale was one-tailed from neutral to positive, rather than negative to positive in other questions, where 1-6 scale was used.

3.1. Data processing

The data analysis was done mainly in SPSS with some validity checks done in Excel. Correlation and regression analyses were mainly used in the thesis. As most of the data was on a Likert scale, linear regression was used. Likert data is ordinal data but has many interval attributes. As Likert scale results function very close to interval data, the main analysis is done using linear regression analysis.

Few of the hypotheses suggested interdependent variables instead of a clear dependent and interdependent variable, so correlation analysis was used in these cases. Spearman's correlation is the main type of correlation analysis as it works for non-linear correlation, but Pearson's correlation is also included in the results to find if there is a linear correlation. As the survey results are not on a completely interval scale, Pearson's correlation coefficient has less importance in findings.

As explained further in the next chapter, differences between nationalities and gender are also studied. This will be done using the Student's t-test.

3.2. Sample analysis

The sample ended up consisting of mainly young, Finnish people. The average age was 22.66 years and the median age was 21. 23 of the respondents were under 20, 51 were 20-24, 9 were 25-29 and 7 were 30+.

A possible major source of respondents from snowballing were many high school students reached by active people in the Union of Upper Secondary School Students in Finland. Otherwise, most respondents had ties to the writer due to the convenience sampling method. Many respondents are likely to be Aalto University Mikkeli Campus' students as the study was shared via e-mail to every student at the campus.

Regarding nationalities, 61 respondents were Finnish. The respondents were from 19 different countries from 5 continents. With some of the findings, differences between Finnish and non-Finnish respondents were studied. As there were only 29 non-Finnish respondents and the respondents were not from truly random countries, the non-Finnish are used mostly as a comparison to the Finnish results.

Finnish	61
American	7
Australian	≤3
British	≤3
Canadian	≤3
Chinese	≤3
Czech	≤3
Dutch	≤3
English	≤3
Estonian	≤3
French	≤3
German	≤3
Hong Konger	≤3
Indian	≤3
Maltese	≤3
Peruvian	≤3
Singaporean	≤3
Swedish	≤3
Vietnamese	≤3

Table 1: Nationalities of respondents

Regarding the education level of respondents, most respondents had declared a bachelor's level or high school studies as their highest level of education. 45.6% had declared high school as the highest level, 36.7% declared bachelor's as highest level, 8.89% declared master's as highest level and 5.56% declared vocational education as highest level. Two people had elementary education as highest level and one person had finished doctoral studies.

I have received feedback from multiple respondents, who were confused by the question and marked their current level of studies as the highest level of education, whilst others marked the highest level of education as the highest degree they have completed. As this can easily create errors in the data, larger statistical analyses were scrapped. As the respondents were mainly young, the demographic of the sample seems to be highly educated compared to the age group, as many have not yet even

had the time to finish possible bachelor's level studies. The educational demographics are not analysed but kept as a baseline for reference.

45 respondents were male, 44 female, whilst one respondent preferred to not disclose gender. The gender distribution is representative of the general population. As male and female genders both have a respectable sample, differences on their results are studied in some cases.

The monetary situation of the respondents was also studied. Many respondents were predicted to be young due to the sampling method and as the monetary situation of young people is highly fluctuating, a perceived monetary situation was asked. The respondents answered on a 1-6 Likert scale, where 1 meant "I am much worse off monetarily" and 6 meant "I am much better off monetarily."

It was expected that people would underestimate their monetary position, but at least the results showed a slight shift to higher values. The mean of the results was 3.67 and the median was 4. Due to the private nature of the question, it was not mandatory. 4 people decided to not answer the question leading to a total of 86 respondents to the specific question keeping a sufficient sample for use in analysis.

4. FINDINGS

4.1. Consumer attitudes on offsets

4.1.1. Perceived effectiveness of carbon offsets

The first research question was "Do consumers have trust in the effectiveness of carbon offsets?" In the survey, the respondents were asked to rate the effectiveness of different environmental sustainability measures. The different measures were picked from major global and Nordic airlines. The most popular measures amongst these airlines were offered as options. The respondents were asked to either rank the tool as Ineffective (1), Mildly effective (2), Effective (3) or very effective (4). The carbon

offsetting was mostly considered to be a mildly effective or effective tool with 80% of respondents picking either 2 or 3.

Compared to other environmental sustainability measures, carbon offsetting had a larger portion of answers in the categories 2 and 3 pointing to less absolute opinions on carbon offsets. In the literature review, some problems with offsetting were pointed out, which could be one reason for less enthusiastic attitudes towards offsetting.

A likely reason is the lower knowledge of offsets which has been the case in earlier studies. The same effect was found also amongst the respondents of this study as seen from the following table.

	Knowledge of environmental issues	Knowledge of carbon offsets
Mean	4.59	3.99
N	90	90
Std. Deviation	1.069	1.276

Table 2: Knowledge of offsets versus general environmental knowledge

H0: Increased knowledge on offsets does not affect the perceived effectiveness of offsets
H1: Increased knowledge on offsets increases the perceived effectiveness of offsets

The results point to a small, but significant increase in the estimated effectiveness of offsets, when a person is more knowledgeable of them. The null hypothesis can be rejected.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.255[a]	.065	.054	.788

Table 3: Model summary on the effect of offset knowledge on the thought effectiveness of offsets

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.853	.274		6.763	.000
	Knowledge on carbon offsets	.162	.065	.255	2.476	.015

Table 4: Coefficients and significance of the effect of offset knowledge on the thought effectiveness of offsets

Out of the sustainability measures, biofuels and fuel-efficient aircraft were considered to be the most sustainable ones. The results are a setback for carbon offsets, but on a positive note, it is good for airlines that there are not many people who have absolute views on carbon offsets and, as such, are more likely to change their opinion. In addition, as airlines have a limited amount of currently reasonable actions they could implement, carbon offsetting cannot be considered off the picture.

	1	2	3	4	Average	Median
Carbon offsetting	8,89%	43,33%	36,67%	11,11%	2,5	2
No single-use plastics	13,33%	30%	35,56%	21,11%	2,64	3
Using biofuels	5,55%	26,67%	37,78%	30%	2,92	3
Newer, more fuel-efficient aircraft	3,33%	25,56%	46,67%	24,44%	2,92	3
Filling seats	8,89%	33,33%	37,78%	20%	2,69	3
Direct flights, no transfers	8,89%	37,78%	34,44%	18,89%	2,63	3
Partnerships with relevant charities	18,89%	50%	21,11%	10%	2,22	2

Table 5: Perceived effectiveness of different sustainability tool used by airlines

4.1.2. Effectiveness of advertising carbon offsets

In the study, an advertisement for an imaginary airline was created to see, if an ad, where an airline claims to offset all their emissions, would increase the brand image of an airline. The full advertisement can be seen from Appendix 3. Both a general airline and the imaginary airline did not see major differences between likeability and modernity. A statistical difference was revealed between other attributes. Both perceived trust and reliability decreased, whilst the airline was perceived to be more caring and environmentally aware. The largest change was with environmental awareness, where the mean had a difference of over 1.5 in a scale of 1-6, which could be seen as a very major change.

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
Adjective		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Distrust - Trust	.778	1.497	.158	.464	1.091	4.928	89	.000

Pair 2	Old-fashioned - Modern	-.122	1.475	.155	-.431	.187	-.786	89	.434
Pair 3	Dislikeable - Likeable	.033	1.554	.164	-.292	.359	.204	89	.839
Pair 4	Environmentally ignorant – Environmentally aware	-1.656	1.756	.185	-2.023	-1.288	-8.946	89	.000
Pair 5	Neglecting - Caring	-.778	1.613	.170	-1.116	-.440	-4.575	89	.000

Table 6: Paired t-test between a general airline and carbon offsetting imaginary airline

4.1.3. Is carbon offsetting considered greenwashing?

In addition to the effectiveness of different greenhouse gas reduction tools, perceived greenwashing was also studied. The greenwashing question was under the fake advertisement. The fake advertisement ended up being considered greenwashing by the vast majority of respondents.

	1	**2**	**3**	**4**	**5**	**6**		**Total**	**Average**	**Median**
Totally disagree	0	9	8	22	30	21	Totally agree	90	4,51	5
	0%	10%	8,89%	24,45%	33,33%	23,33%				
Total	0	9	8	22	30	21		90	4,51	5

Table 7: Perceived greenwashing in the fake advertisement

4.2. Impact of airline emissions on customers

The thesis' rationale regarding economic sustainability was that an environmentally conscious person would start to reduce flying due to the high carbon footprint of flying. In the survey, 34% of respondents at least somewhat agreed that they have reduced flying due to environmental concerns. 16% of respondents totally agreed on the subject. Both of these figures are alarming for airlines.

In addition to just asking people if they have reduced flying, additionally, it was studied, if a person's environmental consciousness would mean that they reduce flying due to environmental concerns. If not, it can be expected that environmentally conscious people do other climate actions rather than reducing emissions.

H0: More environmentally conscious people do not reduce flying due to environmental concerns more than others
H1: Environmentally conscious people reduce flying due to their environmental concerns

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.546[a]	.298	.290	1.486

Table 8: Model summary on the effect of environmental consciousness on reducing flying due to environmental concerns

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.694	.616		-1.128	.263
	I'm environmentally-conscious	.880	.144	.546	6.112	.000

Table 9: Coefficients and significance of environmental consciousness on reducing flying due to environmental concerns

As expected, the null hypothesis can be rejected, and the effect seems to be significant. The R square is also pretty high, so it can be concluded that environmentally conscious people are ready to reduce flying.

To validate results, it was checked if the people who said to have reduced flying had actually reduced flying. This was done by comparing the results to the question, where people were asked to estimate, how many times they've flown during the past 2 years. The results can be validated as the model was significant. If a person had said to reduce flying, they ended up reducing it. In the end, it seems that the purchasing decision is still affected by many other factors as the R square was low.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.241[a]	.058	.047	7.755

Table 10: Model summary on the validation that people, who said to have reduced flying, have actually reduced flying

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.613	1.598		6.643	.000
	Reduced flying due to environmental concerns	-1.084	.466	-.241	-2.325	.022

Table 11: Coefficients and significance of the validation that people, who claimed to have reduced flying, actually have reduced flying

From the demographical analysis, it can be seen, that women seem to be more likely to reduce flying than men due to environmental concerns, but the difference is not that significant as the 2-tailed significance was 0.116. Amongst Finnish and non-Finnish people, the difference was more significant at 2-tailed significance of 0.065. It seems that Finnish people are likelier to reduce flying due to environmental concerns.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Reduced flying due to environmental concerns	Male	45	2.62	1.787	.266
	Female	44	3.20	1.665	.251

Table 12: Gender and reducing flying

	Nationality	N	Mean	Std. Deviation	Std. Error Mean
Reduced flying due to environmental concerns	Finnish	61	3.18	1.821	.233
	Other	29	2.45	1.549	.288

Table 13: Nationality and reducing flying

4.2.1. Impact of social circles on reducing flying

The purchasing habits of people are often affected by social circles. This is likely one of the causes in the spread of flight shame and environmental consciousness and how people start to reduce flying due to environmental concerns.

H0: People start to reduce flying regardless of their social circles.

H1: If people in a person's social circles have reduced flying, the person is likelier to have reduced flying.

The Pearson correlation coefficient was .558 with a 2-tailed significance of .000 and the Spearman correlation was .559 with a 2-tailed significance of .000. Pearson's correlation can be found in Appendix 4. As such, moderately strong correlation was found between the reduction of flights by a person themselves and their social circles. The null hypothesis was able to be rejected.

			I have reduced flying due to environmental concerns	Friends or relatives reduced flying due to environmental concerns
Spearman's rho	I have reduced flying due to environmental concerns	Correlation Coefficient	1.000	.559**
		Sig. (2-tailed)	.	.000
		N	90	90
	Friends or relatives reduced flying due to environmental concerns	Correlation Coefficient	.559**	1.000
		Sig. (2-tailed)	.000	.
		N	90	90

Table 14: Correlation between own carbon offset purchase habit and friends and relatives purchase habits on offsets

4.2.2. Impact of social circles on flight shame

To further validify findings, regression analysis between "flight shame" and the reduction of flying by relatives and friends was also analysed. The linear correlation suggests that if the person's friends or relatives had reduced flying, it would have had a small, but significant effect on a person's flight shame. The R Square is only .112 pointing towards a minor effect in flight shame, but the significance level is .001 suggesting that the minor change is very likely to occur.

It can be assumed that the reduction in flights in Sweden was at least partially caused by the flight shame movement and as such, the level of flight shame could be a good

attribute in validifying the results. As expected, there was a significant correlation between flight shame and circles reducing flying. The R square is only .112 pointing to a significant, but minor effect.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.335[a]	.112	.102	1.723

Table 15: Model summary of the impact of social circles on flight shame

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.952	.389		5.012	.000
	My friends or relatives reduced flying due to environmental concerns	.390	.117	.335	3.332	.001

Table 16: Coefficients and significance of the impact of social circles on flight shame

Looking at the results, flight shame is mainly caused by others than friends and relatives but could be somewhat influenced by them. This could somewhat predict future growth with flight shame as friends and relatives generate flight shame amongst social circles.

4.2.3. Attitudes on flying and airlines

H0: Lesser trust in the airline's environmental actions does not reduce other attitudes of the airline.
H1: Lesser trust in airline's environmental actions reduces overall attitudes on airlines.

In questions 11&12, different adjectives related to flying and airlines were presented. Respondents were asked to pick do they associate flying or airlines with an adjective or its antonym. On flying, respondents were asked if they consider flying environmentally friendly and on airlines, respondents were asked, if they consider airlines environmentally aware.

In Appendix 2, a correlation table for responses for questions 11&12 is presented. As there was no major correlation between many positive attributes with flying and airlines and the environmental awareness of an airline, the null hypothesis is not rejected. When looking at the correlation table, strongest correlation was by far found to be between the likeability of airline with caring, trust and reliability of an airline.

Anyways, some other interesting findings related to the thesis were found. When from the correlation table, the most correlating adjectives with the environmental effect of flying and airlines were picked for further analysis, some useful findings had a possibility to be found. The line was drawn in an arbitrary point of an over 45% Spearman correlation coefficient with a significance of over 95%. With the environmental friendliness of flying, the necessity of flying and likeability of airlines fell into the threshold. With environmental awareness of flying, only caring of airlines correlated with it.

From the results, a new hypothesis was formed where “The necessity of flying increases a person’s likelihood to view flying as more environmental” and “The perceived environmental friendliness of flying increases the likeability of airlines”. Below is a representation of the hypothesis.

Figure 2: Visual representation of the new hypothesis

Looking at the first part of the hypothesis, where the necessity of flying affects perceived environmental friendliness, the regression analysis points to a strong effect by the perceived necessity of flying on the perceived environmental friendliness of flying. In addition, the result seems very significant.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.493[a]	.243	.234	.923

Table 17: Model summary on the model, where the necessity of flying increases a person's view to see flying as more environmental

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.456	.305		1.495	.139
	Adjective flying?:Optional	.388	.073	.493	5.310	.000

Table 18: Coefficients and significance of the necessity of flying on a person's view on flights' environmental effect

The second part of the hypothesis has similar results. Airlines are thought to be more likeable if flying is considered less environmentally damaging.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.513[a]	.263	.255	1.057

Table 19: Model summary of estimated environmental damage on the likeability of an airline

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.727	.239		11.423	.000
	Adjective flying?:Environmentally damaging	.595	.106	.513	5.604	.000

Table 20: Coefficients and significance of estimated environmental damage on the likeability of an airline

4.3. Buyers of carbon offsets

The third research question asked, how willing are customers to pay more for a flight, which emissions are offset. The following histogram shows responses to a question, how much of a flight's price would the respondent be willing to offset. Respondents, in general, wanted to offset around 10% of a flight's price or less.

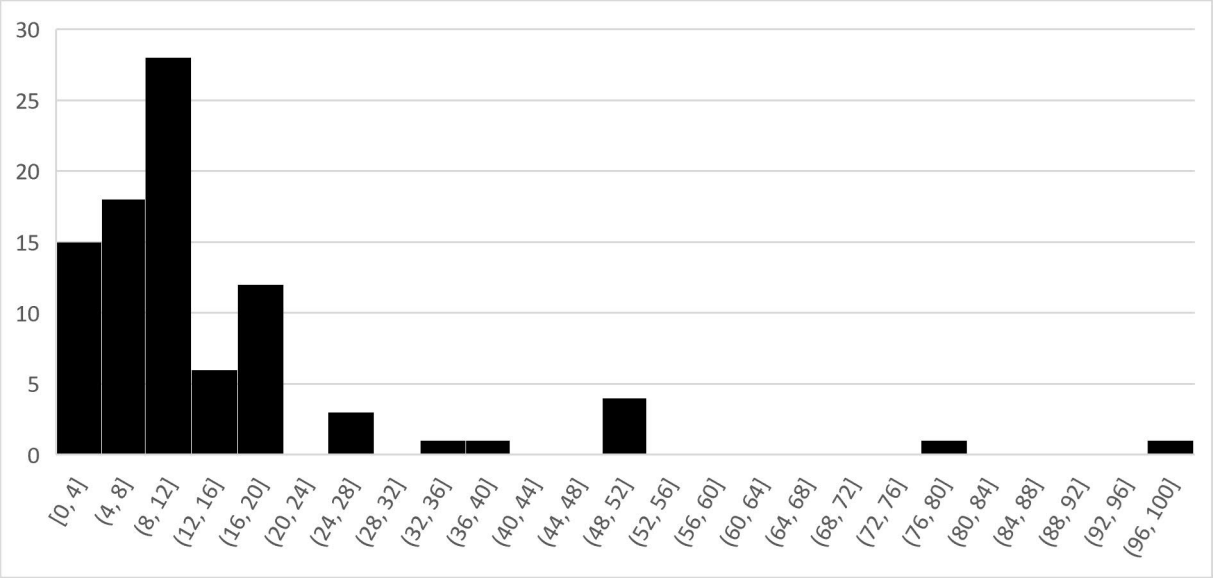

Figure 3: How much a respondent was willing to pay of a flight's price for carbon offsets

Earlier studies have already found that people, who fly a lot are more likely to buy offsets. When looking at geographical differences, Europeans seemed to offset more and short-haul flights were more likely to be offset. The cost of the offsets was also often a significant factor. In addition, some people seemed to buy offsets as it made them happier as they believed to take part in climate protection activities and were a good example.

First, demographical differences were studied. Finnish people were much likelier to buy offsets than people from other countries with a t-value of 2.763 and two-tailed significance of 0.007.

	Nationality	N	Mean	Std. Deviation	Std. Error Mean
I would buy carbon offsets for my flights	Finnish	61	3.93	1.559	.200
	Other	29	2.97	1.546	.287

Table 21: Nationality and willingness to buy offsets

Between men and women, there wasn't such major difference in the willingness to pay for offsets. With a t-value of 1.223 and significance level of 0.225, women seemed to be more likely to buy offsets, but the difference was not significant.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
	Male	45	3.42	1.699	.253

I would buy carbon offsets for my flights	Female	44	3.84	1.524	.230

Table 22: Gender and willingness to buy offsets

Four expected factors to influence the buying habits of offsets in addition to demographical differences were studied with the survey: flight shame, environmental consciousness, perceived effectiveness of offsets and wealth.

4.3.1. Buyers of carbon offsets – Flight shame as a factor

H0: Flight shame has no effect on a person's buying habits
H1: People who have flight shame are more likely to buy offsets to alleviate moral discomfort.

Form the regression analysis, a somewhat significant (.007), but a minor effect (R Square of .079) was found. The offering of carbon offsets is probably not likely to keep many customers from changing to more sustainable alternatives but could work for some. The null hypothesis is not rejected, but the results point to a minor effect.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Flight shame	.282[a]	.079	.069	1.555

Table 23: Model summary of the effects of flight shame on WTP

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.849	.325		8.753	.000
	I have flight shame	.250	.091	.282	2.752	.007

Table 24: Coefficients and significance of flight shame as a factor on WTP

4.3.2. Buyers of carbon offsets – Perceived effectiveness as a factor

H0: People are as likely to buy offsets, no matter, how effective they think the offsets are

H1: People, who think that carbon offsets are more effective, are more likely to buy carbon offsets

The most likely variable could have been estimated to be the perceived effectiveness of offsets. The results surprisingly do not differ much from the results with flight shame. The results could be explained by hedging in answers, as respondents have presented a lot of hedging in their responses with offsets.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.284[a]	.081	.070	1.554

Table 25: Model summary on the model of perceived effectiveness of offsets on WTP

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.212	.534		4.144	.000
	Effectiveness: Carbon offsetting	.564	.203	.284	2.776	.007

Table 26: Coefficients and significance of perceived effectiveness on WTP

4.3.3. Buyers of carbon offsets – Wealth as a factor

H0: An environmentally conscious person will buy offsets, disregarding wealth
H1: An environmentally conscious person is more likely to buy offsets if they are wealthier.

Voluntary carbon offsets cost money and as such, a hypothesis was made, where wealthier people are more likely to use offsets to confirm if offsets could be considered a normal service instead of inferior service. It was estimated that environmental consciousness would have been an intervening variable.

First, it was tested, if wealth itself would have been a factor, but the regression analysis pointed else. There seems to be a positive regression coefficient between buying offsets and wealth, but the results are not significant, so the null hypothesis “there is no positive correlation between wealth and likelihood of buying offsets” is not rejected.

Wealth does seem to have a minor effect on buying offsets, but the purchasing decision can be determined by many other things.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.126[a]	.016	.004	1.589

Table 27: Model summary on wealth modelling the willingness to buy offsets

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.839	.623		4.555	.000
	Monetary situation	.189	.163	.126	1.162	.249

Table 28: Coefficients and significance of wealth on the willingness to buy offsets

In the second test, environmental consciousness was added as it was estimated to be another variable in the hypothesis. After adding environmental consciousness to the model, wealth started to show a larger effect, but it remained minor. The results remained non-significant. The null hypothesis was not rejected, but the results show support to the hypothesis.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.269[a]	.072	.050	1.552

Table 29: Model summary on wealth and environmental consciousness modelling the willingness to buy offsets

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.080	.991		1.090	.279
	I'm environmentally-conscious	.355	.158	.244	2.250	.027
	Monetary situation	.272	.163	.180	1.664	.100

Table 30: Coefficients and significance of wealth and environmental consciousness on the willingness to buy offsets

The results did not see wealth as a significant factor. As the carbon offsets seem to be normal good, a new hypothesis was made. Even though wealthy people would not be much likelier to buy offsets, they might be more likely to pay more for offsets or buy more offsets. As such, this hypothesis was made.

H0: Wealthier people are ready to pay as much for offsets as others

H1: Wealthier people are more likely to pay more for offsets

The results did not back the hypothesis and the null hypothesis was not rejected.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.030[a]	.001	-.011	16.666

Table 31: Model summary on the effect of wealth on, how much a person would spend on offsets

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.260	6.539		1.875	.064
	Monetary situation	.464	1.711	.030	.271	.787

Table 32: Coefficients and significance of the effect of wealth on, how much a person would spend on offsets

4.3.4. Buyers of voluntary offsets – Environmental consciousness as a factor

H0: Environmental consciousness is not a factor when people consider purchasing offsets.

H1: Environmentally conscious people are more likely to purchase offsets

In the earlier chapter, environmental consciousness was studied as a factor with wealth and increased the significance of the model. The last hypothesis was that environmental consciousness itself would be a factor. Unlike earlier factors, the significance value fell to almost 3% and null hypothesis was able to be rejected. The effect still does not seem to be that major, but it is significant.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.227[a]	.051	.041	1.579

Table 33: Model summary of the environmental consciousness is a factor on a carbon offset purchasing decision

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.242	.654		3.428	.001
	I'm environmentally-conscious	.334	.153	.227	2.182	.032

Table 34: Coefficients and significance if the environmental consciousness is a factor on a carbon offset purchasing decision

5. DISCUSSION AND ANALYSIS

5.1. Customer attitudes on offsetting

The respondents seemed to have mild opinions on offsetting. Even though offsetting was considered less effective than other widely used sustainability tools in the airline industry, almost every respondent considered offsetting at least somewhat effective.

A good theory, why people might not have strong positive opinions on offsetting might be the general lack of understanding of them. As in earlier surveys, people had a lower understanding of offsets than the general environmental knowledge also in this survey. Respondents, on average, seemed to have some understanding on offsets but claimed to not be very knowledgeable. As people would not know as much about the topic, they might not form as strong opinions, which would result in more hedging responses.

When no cost is considered, biofuels and new fuel-efficient planes seemed to more favoured than carbon offsets. As already explored in the literature review, there seem to be possible supply problems for large-scale utilization of biofuels in the airline industry. Biofuels could start to be created using more prime materials but creating biofuel from waste has much higher emission reductions compared to prime materials. Even though biofuels generated from prime materials are renewable, the emissions level is quite high. In addition, much of the biofuel used by airlines includes palm oil, which production has been found to cause deforestation undermining the environmental benefits of biofuels.

Biofuels are supposed to be used in CORSIA alongside carbon offsets, which increased the demand for it. As both biofuels and carbon offsets have limited supply, companies are possibly forced to use both instead of the other. The ongoing COVID-19 pandemic increases the problem as the current emissions of airlines are falling and airlines in countries, which are part of CORSIA, should not exceed their 2019-2020 emission levels.

Newer, more fuel-efficient planes seem to be seen as an effective solution. A more fuel-efficient plane is going to reduce the carbon footprint of a flight, but as long as combustion engines are used with planes, the combustion powertrain will emit a lot of emissions no matter if the plane is new. The plane's emissions are just not going to be that high. Electric and other new powertrains are developed, but they are either in concept or prototype stage and are not relevant yet.

A part of the survey was the imaginary advertisement, where a fake airline advertised that they have offset all their flights' emissions. This airline was considered more caring and environmentally aware than a general airline. On the other hand, the fake airline was thought to be less trustworthy and reliable, which is not as good sign. It could be attributed to the non-existent brand of the fake airline, as the fake airline would have not been able to create customer trust or, by offering carbon offsets, people lose trust on an airline.

5.2. Impact of airline emissions on customers

Respondents seemed to react to the negative image created by high emissions of airlines. About third of the respondents claimed to have reduced flying due to environmental concerns. People in this group were likelier to be more environmentally conscious in general, as expected. There was also a clear connection between a lower flight count and claims that the person has reduced flying. Even though there are many other factors affecting the flight count of a person, some people truly seem to have started to reduce flying due to environmental concerns, which can be a problem for airlines.

When looking at the attitudes on flying and airlines, the hypothesis that an airline's environmental awareness did not significantly increase the attitudes of an airline was not confirmed. The estimated environmental damage of flying as well did not seem to make a significant effect on the general attitudes around flying. Some other findings from offsetting were able to be found.

If flying was considered to be necessary, the responder was much more likely to not think of flying as environmentally damaging. In addition, if flying was thought to not be damaging for the environment, the responder was much more likely to like a general airline. Some attributes, like trust, convenience and speed did not seem to care about the environmental performance of a general airline.

Women and Finnish people seemed to be more likely to reduce flying, but the results are inconclusive. Finland seems to be in the same group as Sweden as one of the first markets where climate change would start to affect the airline industry. Whilst in Sweden, people have started to fly less, in Finland, the industry was growing until the COVID-19 coronavirus outbreak. In Sweden, many people had voiced concerns about the emissions until the effect started to show in national statistics. It might be that Finland will soon follow Sweden's lead as the potential at least amongst the youth is there.

In addition, the importance of social circles on flying habits amongst the respondents was confirmed. People, whose friends or relatives have reduced flying are more likely to reduce flying themselves. Two main theories for the result could be given. The first theory is that friends and relatives influence each other's climate consciousness or that people make friends with people with similar ideologies and end up in social circles with similar consuming habits. The combination of the two is the most likely response.

Social circles were found to have an effect on flight shame in addition to the abovementioned consuming habits. People with flight shame should be more likely to reduce flying, but by climate action, which is found to be effective, these people should be able to be retained as customers.

5.3. Buyers of offsets

Most respondents are willing to pay around 10% of a flight's price for offsets or even less. Currently, the price for certified carbon offsetting seems to be a bit under 5€/1000km flight or a bit over 5€/1h of flying time. Offsetting projects could be found for significantly cheaper, but the cheaper offsets are often non-certified and have less rigorous demands for greenhouse gas reductions.

Offsetting projects can also be much more expensive. These projects are often taken place in highly developed countries, where costs are high. If the offsetting project is done close to home, a person is more likely to see the impact and might be willing to pay a premium for it.

The price of biofuels is currently much higher. SAS, for example, currently charges customers 30€ per 1h of flying time, if they would want to buy biofuel corresponding to the fuel consumption of a flight. This price is much higher than the price of offsets, which could make offsets preferred choice even though it is estimated to be less effective.

Whilst gender didn't seem to be a significant factor in responder's willingness to offset, the nationality was. Finnish people claimed to be likelier to offset their emissions. This is in line with the earlier studies, wherein Europe and especially in Sweden, another Nordic country, people were willing to offset a flight's emissions more than in other continents. The combined results affirm that European and especially Nordic markets are likeliest to have the highest demand for offsets.

Another major factor alongside nationality was the environmental consciousness of a person. As expected, more environmentally conscious people were more ready to pay for offsets. This shows the potential to retain customers using carbon offsets.

As the estimated effectiveness and flight shame did not seem to have a significant effect contrary to the hypothesis. This could somewhat reduce the importance of some other findings as the effectiveness of offsets and flight shame are not that connected with carbon offset purchasing decisions.

It was especially surprising that people seem to be willing to buy carbon offsets no matter their effectiveness. As environmental consciousness was a much more significant factor, it could be theorized that people are willing to trust in carbon offsets in a lack of better options, even though they are not certain of its effect.

Even though a person's wealth was hypothesized to be a significant factor in the likelihood of buying offsets, the data did not provide any significant results, even when adjusted to environmental consciousness. In addition, another test was made, where wealth was estimated to increase the share of a flight's price a person would be willing to spend on carbon offsets, but the model seemed to be very insignificant and pretty useless. It could though be concluded from the results that the carbon offsets are more likely to be a normal good than an inferior good.

5.4. Conceptual framework's relevance

The conceptual framework does seem to somewhat hold its own when compared with the results. First when looking at social acceptance, the hypothesis that purchasing habits are influenced by social circles was accepted. If this effect would also influence carbon offset purchasing habits, the social acceptance's place is not unjustified.

The fake advertisement in the survey was considered by many to be greenwashing. Greenwashing has a very negative connotation so it can be expected to hurt purchasing decisions. As greenwashing allegations were made by many responders, greenwashing is a good part of the conceptual framework.

Even though the trust was not directly studied that much, it was a recurring theme in findings. The greenwashing allegation could be attributed to the lower trust created by the novelty of the fake brand, which could make it harder to retain customers. In addition, in the last section, trust was a theorized example on why people were ready to buy carbon offsets even though they weren't sure about the effectiveness.

One of the strongest parts of the conceptual framework seems to be the importance of a lack of substitutes. From the survey, it was found that consumers prefer some other

sustainability tools, like biofuels and more fuel-efficient planes. In addition, in the literature review, it was found that people are likely to switch to high-speed rail if it is an option to a short-haul flight. Both offsetting and flying are then likely to be substituted if there are substitutes available.

The effects of the understanding of offsets were studied. People, who understood offsets better, were also more likely to think them as effective. Even though it wasn't a big factor, the framework is likely to benefit from the inclusion of understanding. On another note, the "ease" part in the factor seems to be somewhat separate from understanding and wasn't studied in the end. It probably could be dropped.

Another strong part is the cost. As most responders wanted to pay 10% or under of a flight's price for carbon offsets, costs might scare them off carbon offsets. Cost is also the competitive advantage of offsets over biofuels. The conceptual framework could have been used more effectively in the study, but it still seems to hold its place.

5.5. Limitations

There was a major pivot in methodology quite late in the thesis process from qualitative to quantitative analysis. This resulted in a survey, which had more questions than necessary as a safeguarding tool. The survey could have been more focused with less, but more fitting questions, but ended up being useful towards research objectives and as such, did well fill its purpose. Some questions were not used in quantitative analysis, but it was better than having questions missing that should've been in the survey.

Most of the questions in the survey were created using the Likert scale. As Likert scale is an ordinal scale, using linear regression could have become a problem. After closer look at the results from the survey, the data seemed to behave like an interval scale would with smooth intervals between response options. The linear regression was such justified to be used. As most responses were on the same scale, in a bad scenario, a responder could have started to fill similar answers to all questions, which would skew results.

In the survey, most questions asked a person's attitude on a subject. Even though both people would respond to these questions the same way, in the real world, the actual actions might differ from each other. This is a limitation that is hard to get rid of without field research, which was out of scale for a Bachelor's thesis.

Due to the young respondents, the findings are likely restricted to youth and younger adults. As younger people get older, it is likely that their consuming habits become more and more prevalent. If the youth is experiencing, for example, strong flight shame, there is a good likelihood that the flight shame will spread in the future.

In addition, the survey was done using the convenience sample and authors' contacts are overrepresented in the sample. This makes claims, where results from the sample are outright projected for the population. The sample, fortunately, did not get a significant majority of the responses from one gender, education level or wealth level, so there was likely to be some variance amongst the population, which makes the case stronger for cautiously using the results outside just the sample. As already discussed in the sample analysis section, Finnish people were a significant majority in the sample. There should be additional caution if results are used in other countries.

6. CONCLUSIONS

6.1. Main findings

The survey respondents seemed to be somewhat sceptical of carbon offsets, as many other sustainability actions were considered to be more effective. Earlier studies already found that people have a lesser understanding of carbon offsets than knowledge about the environment in general and the thesis' findings follow the same line. The knowledge of offsets seems to be a factor in trust in offsets, which could explain the scepticism. On the other hand, not many people denied the effectiveness of offsets altogether and there was a lot of hedging in the answers, which could mean higher potential for changes in opinions.

As expected, some people have reduced flying due to environmental concerns. This links the environmental and economic sustainability of airlines closer to each other. The environmental consciousness of relatives and friends was also found to affect peoples' own purchasing decisions to more conscious ones.

Currently, there seems to be a good supply of carbon offsets and the prices are relatively low, but after the implementation of CORSIA, the demand is likely to rise, which likely increases prices. Most respondents were ready to pay 5-15% of a flight's price, which means that depending on a flight's price, most respondents would be willing to offset at least some or all emissions of a flight.

6.2. Implications for airlines

The environmental sustainability toolset for airlines is a limited one. The main operation of flying is currently very dependent on combustion technology. Airlines can, by increasing the fuel efficiency of operations, decrease their carbon footprint in a way that consumers view to be somewhat effective. Newer, more fuel-efficient aircraft was considered by the respondents to be a highly effective tool.

The longevity of aircraft fitted with conventional combustion engines could be a risk if greener technology would make them obsolete. The likelihood of this happening very soon is low, but aircraft usually have a long lifespan and predicting way ahead into the future of technological progress is very difficult and outside a bachelor's thesis' range. By utilizing a higher passenger capacity and flying more direct routes, airlines can increase fuel-efficiency without committing to large investments in new aircraft.

The partnerships with environmental charities were seen as the least effective solution pointing to a respondents' desire for concrete environmental action. People seem to be ready to call vague environmental actions by airlines as greenwashing, so airlines should consider transparency.

The main competing tool with carbon offsetting project seems to be biofuels. The respondents seemed to attribute more positive attributes with biofuels than offsets, but

both might not reach demand after the implementation of CORSIA if the supply is not increased. Airlines could now start to establish good supply chains of offsets so that they would not run out.

Currently, as the attitudes towards offsetting do not seem to be that absolute, airlines could benefit from good PR surrounding the topic. As the understanding of offsets increases the willingness to pay for them, airlines would benefit from increased knowledge on the subject rather than keeping offsetting vague. Carbon offsetting still seems to be one of the most cost-effective environmental sustainability measures and if customers would start to trust it, it could be a great benefit to airlines. As offsetting is not considered that effective at the moment, offering offsets as an optional solution is likely a safer bet than integrating them into every ticket.

If airlines would like to market offsetting in a way that consumers would see in a positive way, a more elaborate marketing strategy is likely needed. Offering voluntary offsets is probably the least risky way of implementing carbon offsets but could be seen as evading responsibility from airlines.

It is nowadays easier to target advertisements. Airlines could benefit from this by focusing their advertisement campaigns related to carbon offsetting to people, who would value a more caring and environmentally aware airline.

The airline in the fake advertisement was seen as more caring and environmentally friendly, but less reliable and trustworthy. The lesser reliability and trustworthiness could be attributed to the fact that the airline in the question was not an established one. This alongside the results from the correlation analysis that points out that airlines must do much more than be environmentally sustainable if a large base of customers is going to have positive opinions on them. Environmental sustainability is likely to not work as a sole main strategy. When an airline would be driving for more sustainable operations, other parts of the brand should not be forgotten.

As people, who think that flying is necessary, find flying less damaging to the environment, airlines might benefit from focusing on long-haul flights, where there are fewer substitutes available to customers. In addition, airlines could focus on markets,

which do not have many land connections as rail travel seems to be threatening the market share of airlines in transportation.

6.3 Relevance to other industries

Carbon offsets can be used by any industry, so the results are somewhat relevant to them. An important factor to consider is that the airline industry has few sustainability tools for use as the main operation is dependent on fuel, which is hard to produce in a carbon-neutral manner. Aviation is also hard to be substituted, especially when looking at long-haul flights and rapid travelling methods. As carbon offsetting seems to be thought as not that effective, other industries should primarily look for better sustainability tools. If the industry lacks valid sustainability tools, carbon offsets are an inexpensive way to reduce a company's emissions.

6.4. Suggestions for future research

The thesis had a focus on the environmental and economic sustainability of airlines. Future research could more focus on larger profitability of environmental actions and integrate social sustainability into the topic.

Future research could look at the differences between different types of offsets and how people would react to them. As the projects vary from location, certification, type and much more, it could be that much more nuanced opinions would be found, when different carbon offsetting options would be introduced in research.

As the survey used a convenience sample, future research could use a type of random sample, which would make results easier to be generalized for a population.

Big technological leaps with aircraft engines could make an airline's sustainability goals much easier to reach and it could be an interesting thing to study. The fuel-efficiency of current technology has seemed to increase quite steadily this century and a change to that would be a big change to the industry.

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8. APPENDICES:

Appendix 1: Survey

1. Your highest level of education
2. Gender
3. Age
4. Nationality
5. How would you describe your monetary situation compared to your AGE GROUP? NOTE: The question is optional.
6. I am an environmentally-conscious consumer
7. Please estimate how important following factors are, when picking a form of transportation (1=Not a factor 2=Not that important 3=Important 4=Very important)
8. Please estimate how times have you flown during the past 2 years? NOTE: roundtrips count as 2 flights

9. Please estimate, what percentage of these flights would you have been able to travel using a different mean of transportation?
10. Please estimate, which percentage of these flights were business trips or trips organized and paid by a different entity.
11. What adjectives do you associate with flying?
12. What adjectives do you associate with airlines in general?
13. I have reduced flying due to environmental concerns
14. My friends or relatives have reduced flying due to environmental concerns
15. I have flight shame when flying.Flight shame is defined, amongst other definitions, as "the feeling of climate guilt associated with airline travel
16. I have good knowledge on environmental issues.
17. I have good knowledge on carbon offsets, also known as carbon compensation
18. Please rate the effectiveness of different environmental sustainability schemes used by airlines. (1=Ineffective 2=Mildly effective 3=Effective 4=Very effective)
19. I would buy carbon offsets for the emissions of my flights
20. What percentage of the flight's initial price would you be willing to pay to offset the flight's emissions?
21. Offsetting emissions enables me to fly more
23. What adjectives would you associate with the imaginary airline?
24. A similar advertisement would make me more likely to purchase flights from the respective airline?
25. I consider the advertisement greenwashing. (Greenwashing is defined, amongst other definitions, as "the act of misleading customers and potential customers into believing that a product or service is environmentally friendly.")
26. I consider the advertisement truthful
27. I consider the advertisement informative

Appendix 2: Correlation table for attitudes on airlines and flying

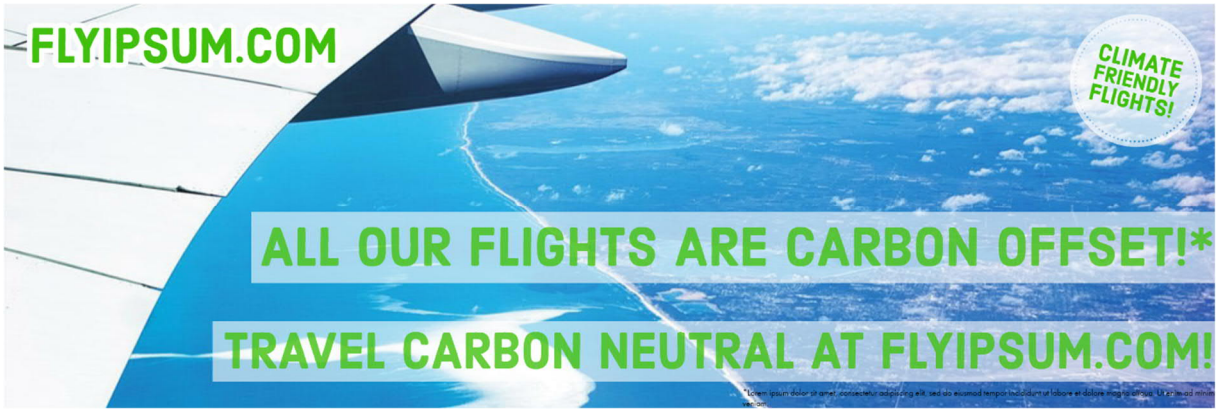
Correlations

			Adjective flying?: Environmentally damaging	Adjective flying?:Slow	Adjective flying?: Inconvenient	Adjective flying?: Uncomfortable	Adjective flying?: Optional	Adjective airlines?: Distrust	Adjective airlines?:Old-fashioned	Adjective airlines?: Dislikeable	Adjective airlines?: Environmentally ignorant	Adjective airlines?: Unreliable	Adjective airlines?: Neglecting
Spearman's rho	Adjective flying?: Environmentally damaging	Correlation Coefficient	1.000	.207*	.330**	.407**	.490**	.364**	.308**	.497**	.514**	.373**	.428**
		Sig. (2-tailed)	.	.050	.001	.000	.000	.000	.003	.000	.000	.000	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective flying?:Slow	Correlation Coefficient	.207*	1.000	.515**	.288**	.313**	.312**	.378**	.323**	.165	.265*	.240*
		Sig. (2-tailed)	.050	.	.000	.006	.003	.003	.000	.002	.119	.012	.023
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective flying?: Inconvenient	Correlation Coefficient	.330**	.515**	1.000	.487**	.311**	.252*	.453**	.359**	.287**	.366**	.423**
		Sig. (2-tailed)	.001	.000	.	.000	.003	.017	.000	.001	.006	.000	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective flying?: Uncomfortable	Correlation Coefficient	.407**	.288**	.487**	1.000	.227*	.448**	.302**	.518**	.381**	.403**	.526**
		Sig. (2-tailed)	.000	.006	.000	.	.031	.000	.004	.000	.000	.000	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective flying?:Optional	Correlation Coefficient	.490**	.313**	.311**	.227*	1.000	.316**	.343**	.414**	.278**	.424**	.329**
		Sig. (2-tailed)	.000	.003	.003	.031	.	.002	.001	.000	.008	.000	.002
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective airlines?: Distrust	Correlation Coefficient	.364**	.312**	.252*	.448**	.316**	1.000	.338**	.648**	.273**	.548**	.447**
		Sig. (2-tailed)	.000	.003	.017	.000	.002	.	.001	.000	.009	.000	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective airlines?:Old-fashioned	Correlation Coefficient	.308**	.378**	.453**	.302**	.343**	.338**	1.000	.430**	.232*	.433**	.368**
		Sig. (2-tailed)	.003	.000	.000	.004	.001	.001	.	.000	.028	.000	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective airlines?: Dislikeable	Correlation Coefficient	.497**	.323**	.359**	.518**	.414**	.648**	.430**	1.000	.400**	.649**	.644**
		Sig. (2-tailed)	.000	.002	.001	.000	.000	.000	.000	.	.000	.000	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective airlines?: Environmentally ignorant	Correlation Coefficient	.514**	.165	.287**	.381**	.278**	.273**	.232*	.400**	1.000	.237*	.499**
		Sig. (2-tailed)	.000	.119	.006	.000	.008	.009	.028	.000	.	.025	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective airlines?: Unreliable	Correlation Coefficient	.373**	.265*	.366**	.403**	.424**	.548**	.433**	.649**	.237*	1.000	.571**
		Sig. (2-tailed)	.000	.012	.000	.000	.000	.000	.000	.000	.025	.	.000
		N	90	90	90	90	90	90	90	90	90	90	90
	Adjective airlines?: Neglecting	Correlation Coefficient	.428**	.240*	.423**	.526**	.329**	.447**	.368**	.644**	.499**	.571**	1.000
		Sig. (2-tailed)	.000	.023	.000	.000	.002	.000	.000	.000	.000	.000	.
		N	90	90	90	90	90	90	90	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 3: Imaginary advertisement



Appendix 4: Pearson's correlation between own carbon offset purchase habit and friends and relatives purchase habits on offsets

Correlations

		Reduced flying due to environmental concerns	My friends or relatives reduced flying due to environmental concerns
Reduced flying due to environmental concerns	Pearson Correlation	1	.558**
	Sig. (2-tailed)		.000
	N	90	90
My friends or relatives reduced flying due to environmental concerns	Pearson Correlation	.558**	1
	Sig. (2-tailed)	.000	
	N	90	90